Large Single-Molecule Fluorescence Enhancements Produced By A Bowtie Nanoantenna

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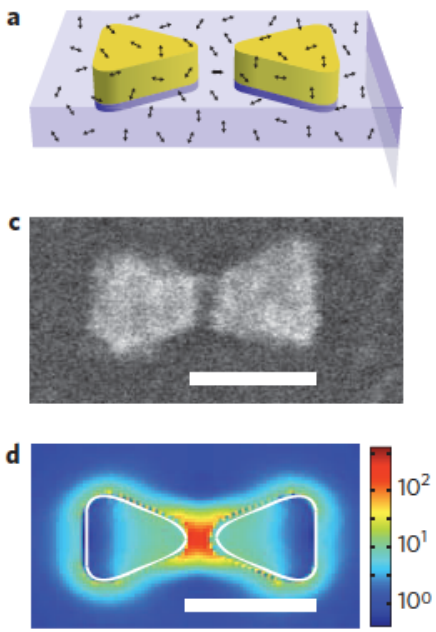
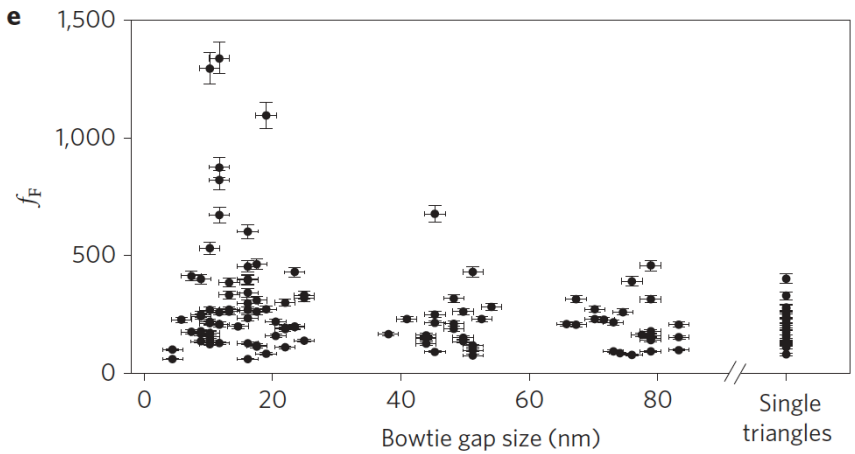
Owing to the size mismatch between light and nanoscale objects such as single molecules, it is important to be able to control light–molecule interactions. Although sharp metal tips and colloids can enhance fluorescence, the highly enhanced optical fields of lithographically fabricated bowtie nanoantennas provide a structure that is more controllable and amenable to integration. Using gold bowties, we observe enhancements of a single molecule's fluorescence up to a factor of 1,340, ten times higher than reported previously, and excited state lifetimes below 20ps. Electromagnetic simulations reveal that this is a result of greatly enhanced absorption and an increased radiative rate, leading to enhancement of the intrinsic quantum efficiency. Bowtie nanoantennas thus show great potential for high-contrast selection of single nanoemitters.



a) Schematic of bowtie nanoantenna (gold) coated with TPQDI molecules (black arrows) in PMMA (light blue) on a transparent substrate. c) Scanning electron microscopy (SEM) image of a gold bowtie nanoantenna. Scale bar, 100 nm. d) Finite-difference time-domain calculation of local intensity enhancement. Scale bar, 100 nm.



Measurement of the fluorescence brightness enhancement factor f_F for single fluorescent molecules as a function of bowtie gap size.

REFERENCE:
"Large Single-Molecule Fluorescence Enhancements Produced By A Bowtie Nanoantenna"
A. Kinkhabwala, Z. Yu, S. Fan, Y. Avlasevich, K. Mullen, and W. Moerner, *Nature Photonics*, **3** (2009)